CLAIMS

What is claimed is:

1   An echo canceller circuit comprising:

a downlink activity and double talk probability data generator operative to receive pre-echo canceler uplink data and downlink data, and in response to produce double talk probability data and downlink activity data; and

an echo canceler stage, operatively coupled to the downlink activity and double talk probability data generator, and operative to receive the downlink data, the pre-echo canceler uplink data, the double talk probability data, and the downlink activity data, and in response to produce uplink data.

2   The echo canceler circuit of claim 1 wherein the echo canceler stage includes an echo canceller adaptive filter operatively coupled to the downlink activity and double talk probability data generator, and operative to receive the double talk probability data, the downlink activity data and the downlink data, and in response to dynamically vary a rate of echo cancellation adaptation.

3   The echo canceler circuit of claim 2 wherein the rate of echo cancellation adaptation is controlled in response to an adaptation gain based on at least the double talk probability data.

4   The echo canceler circuit of claim 1 wherein the echo canceler stage further includes:

adder logic operative to receive the pre-echo canceler uplink data and echo estimation data, and in response to produce post-echo canceler uplink data;

echo power and confidence estimator logic, operatively coupled to the downlink activity and double talk probability data generator, and operative to receive

the downlink activity data and the double talk probability data, and in response, to produce residual echo power data and performance confidence factor data; and

an uplink data attenuator, operatively coupled to the adder logic and the echo power and confidence estimator logic, and operative to receive the post-echo canceler uplink data, the residual echo power data and the performance confidence factor data, and in response to attenuate the post-echo canceler uplink data to produce the uplink data.

5   The echo canceler circuit of claim 4 wherein the echo power and confidence estimator logic further includes:

a residual echo power estimator data generator, operatively coupled to the downlink activity and double talk probability data generator and the uplink data attenuator, and operative to receive the downlink activity data and the double talk probability data, and in response to produce the residual echo power data; and

a performance confidence factor data generator, operatively coupled to the downlink activity and double talk probability data generator and the uplink data attenuator, and operative to receive the downlink activity data and the double talk probability data, and in response to produce performance confidence factor data.

6   The echo canceler circuit of claim 1 wherein the downlink activity and double talk probability data generator further includes:

a downlink activity data generator, operatively coupled to the echo canceler stage, and operative to receive downlink data, and in response to produce the downlink activity data; and

a double talk probability data generator, operatively coupled to the echo canceler stage, and operative to receive the pre-echo canceler uplink data and in response to produce the double talk probability data.

7   An echo canceler circuit comprising:

a downlink activity and double talk probability data generator operative to receive pre-echo canceler uplink data and downlink data, and in response to produce double talk probability data and downlink activity data;

an echo canceller adaptive filter operatively coupled to the downlink activity and double talk probability data generator and operative to receive the double talk probability data, the downlink activity data and the downlink data, and in response to dynamically vary a rate of echo cancellation adaptation and to produce echo estimation data;

adder logic, operatively coupled to the echo canceler adaptive filter, and operative to receive the pre-echo canceler uplink data and the echo estimation data, and in response to produce post-echo canceler uplink data; and

echo power and confidence estimator logic, operatively coupled to the adder logic, and the downlink activity and double talk probability data generator, and operative to receive the downlink activity data and the double talk probability data, and in response to produce residual echo power data and performance confidence factor data.

8   The echo canceler circuit of claim 7 wherein the downlink activity and double talk probability data generator further includes:

a downlink activity data generator, operatively coupled to the echo canceller adaptive filter, and operative to receive the downlink data, and in response to produce the downlink activity data; and

a double talk probability data generator, operatively coupled to the echo canceller adaptive filter, and operative to receive the pre-echo canceler uplink data, and in response to produce the double talk probability data.

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9   The echo canceler circuit of claim 7 wherein the rate of echo cancellation

adaptation is controlled in response to an adaptation gain based on one minus the double talk

probability data.

10   The echo canceler circuit of claim 7 including:

a digital to analog converter operative to receive the downlink data,

and in response to produce a downlink audio signal;

an amplifier, operatively coupled to the digital to analog converter, and

operative to receive the downlink audio signal, and in response to produce an

amplified downlink audio signal;

a microphone, operative to receive at least a portion of the amplified

downlink audio signal, and in response to produce a pre-echo canceler uplink signal;

and

an analog to digital converter, operatively coupled to the microphone,

the adder logic and to the downlink activity and double talk probability data

generator, and operative to receive the pre-echo canceler uplink signal, and in

response, to produce the pre-echo canceler uplink data.

11   A communication apparatus, comprising:

a housing having coupled therewith:

an echo canceler circuit within the housing comprising:

a downlink activity and double talk probability data generator

operative to receive pre-echo canceler uplink data and downlink data, and in response

to produce double talk probability data and downlink activity data; and

an echo canceler stage, operatively coupled to the downlink

activity and double talk probability data generator, and operative to receive the

downlink data, the pre-echo canceler uplink data, the double talk probability data and

the downlink activity data, and in response to produce uplink data; and

       a transceiver within the housing operatively coupled to the echo

canceler stage, and operative to receive the uplink data, and in response to transmit

the uplink data.

12   The communication apparatus of claim 11 wherein the transceiver is at least

one of: a wireless wide area network (WWAN) transceiver and a wireless local area network

(WLAN) transceiver.

13   The communication apparatus of claim 11 wherein the communication

apparatus is included in at least one of a speaker phone and a telephone.

14   The communication apparatus of claim 12 further including a location

information generator operative to produce location information, wherein the echo canceller

circuit includes:

       one or more processing devices operatively coupled to the location

information generator; and

       memory containing instructions executable by the one or more

processing devices to cause the one or more processing devices to provide the

location information to the transceiver, wherein transceiver transmits the location

information.

15   The communication apparatus of claim 11 wherein the transceiver receives

downlink audio data, and in response provides the downlink audio data to the echo canceler

circuit.

16   An in-vehicle communication system comprising:

       an echo canceler circuit comprising:

a downlink activity and double talk probability data generator operative to receive pre-echo canceler uplink data and downlink data, and in response to produce double talk probability data and downlink activity data;

an echo canceler stage, operatively coupled to the downlink activity and double talk probability data generator, and operative to receive the downlink data, the pre-echo canceler uplink data, the double talk probability data, and the downlink activity data, and in response to produce uplink data;

a wireless transceiver operatively coupled to the echo canceler stage and operative to receive the uplink data and in response to transmit the uplink data;

an audio system including:

an amplifier, operatively coupled to the echo canceler circuit, and operative to receive the downlink data, and in response to produce an amplified downlink audio signal; and

a playback stage including at least one of : a tuner stage, a tape player, a CD player, a DVD player and a hard drive, operatively coupled to the amplifier, and operative to provide at least a playback audio signal to the amplifier.

17   The in-vehicle communication system of claim 16 wherein the transceiver is at least one of: a wireless wide area network (WWAN) transceiver, a wireless local area network (WLAN) transceiver, and a wireless device.

18   The in-vehicle communication system of claim 16 wherein the echo canceler stage includes an echo canceller adaptive filter operatively coupled to the downlink activity and double talk probability data generator, and operative to receive the double talk probability data, the downlink activity data and the downlink data, and in response to dynamically vary a rate of echo cancellation adaptation.

19   The in-vehicle communication system of claim 18 wherein the rate of echo

cancellation adaptation is controlled in response to an adaptation gain based on the double

talk probability data.

20   A method for reducing an echo signal comprising:

        receiving pre-echo canceler uplink data and downlink data;

        generating downlink activity data in response to the received pre-echo

canceler uplink data and the downlink data;

        generating double talk probability data in response to the received pre-

echo canceler uplink data and the downlink data; and

        echo canceling the pre-echo canceler uplink data in response to the

downlink data, the downlink activity data and the double talk probability data to

produce post-echo canceler uplink data.

21   The method of claim 20 wherein echo canceling the pre-echo canceler uplink

data further includes dynamically varying a rate of echo cancellation adaptation when

downlink speech is detected based on at least the downlink activity data.

22   The method of claim 21 wherein the rate of echo cancellation adaptation is

dynamically varied in response to an adaptation gain based on one minus the double talk

probability data.

23   The method of claim 20 including attenuating the post-echo canceler uplink

data in response to the downlink activity data and the double talk probability data to produce

uplink data.

24   Memory containing instructions executable by one or more processing devices

that causes the one or more processing devices to:

        receive pre-echo canceler uplink data and downlink data;

generate downlink activity data in response to the received pre-echo canceler uplink data and the downlink data;

generate double talk probability data in response to the received pre-echo canceler uplink data and the downlink data; and

echo cancel the pre-echo canceler uplink data in response to the downlink data, the downlink activity data and the double talk probability data to produce post-echo canceler uplink data.

25   The memory of claim 24 containing executable instructions that cause the one or more processing devices to:

dynamically vary a rate of echo cancellation adaptation when downlink speech is detected based on at least the downlink activity data.

26   The memory of claim 24 containing executable instructions that cause the one or more processing devices to:

attenuate the post-echo canceler uplink data in response to the downlink activity and double talk probability data to produce the uplink data.